

NATURAL GAS FED PC25C FUEL CELL POWER PLANT

FINAL REPORT FOR THE US DEPARTMENT OF ENERGY

Covering Field Experience

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ABSTRACT

This report details the performances obtained during the first year of operation by the Natural Gas Fed PC25C™ Power Plant installed in the city of Nurnberg (Germany).

The Owner of the Power Plant is the Energie und Wasserversorgung AG, energy and water supply corporation involved in the distribution of electricity, gas and water in the area of Nurnberg .

The power plant is operated by Erdgas Energie Systeme Gmbh a company located in Essen. This company is also involved in operations of other PC25 power plants in Germany.

Information is provided on the resulting electrical and thermal performances, reliability and Mean Time Between Failure factors and moreover an evaluation of the cost benefits.

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1. EXECUTIVE SUMMARY

The fuel cell technology promises to alter the huge markets for power generation equipment. Countries that first commercialize the technology will gain significant competitive advantage.

Small scale generators (up to the MW size), as needed to approach the commercial, residential and light industrial sectors have to satisfy two requisites in order to compete with the present and perspective configuration of central power generation and urban distribution:

?? their electrical efficiency, including avoided losses in transmission and distribution, should approach 50% which is probably a upper limit for the average electricity generating park of the future

?? their environmental impact (gaseous emissions, electromagnetic interference, noise, physical dimensions) should be kept to a minimum.

The relatively small size and the very good total efficiency, like the commercially available ONSI PC25 Model CTM phosphoric acid fuel cell power plant, also make cogeneration a better match for several types of applications, as sport and leisure centers, hospitals, housing estate and offices.

2. INTRODUCTION

Fuel cell technology has a definite advantage compared to other technologies such as very low pollutant emission, low noise and vibration and ability to perform scheduled quarterly maintenance while the power plant is operating. Particularly, concerning the emissions the Nox content in the exhaust gases is less than that in gas engines by a factor of hundred and in reducing CO₂ emissions, they can be as effective as photovoltaics or wind and even more if they are fed by non fossil hydrogen.

ONSI PC25 phosphoric acid fuel cell power plants have reached an industrial state development: world PC25 fleet has exceeded 2 millions operating hours.

PC25 power plants are installed in USA, Europe and Asia and fuels presently suitable for use by the phosphoric acid fuel cell include natural gas or propane, and hydrogen. Units have also successfully operated on municipal sewage treatment plant digester gas.

3. RESULTS AND DISCUSSION

The values of the parameters indicated afterwards are related to the period starting from 01/01/1998 up to 12/31/1998

THERMAL OUTPUT

The fuel cell 9147 in Nuremberg is connected to an absorption heat pump to increase the thermal output of the power plant. The return and supply temperatures of the hot water loop are about 50-55/70°C.

That would mean a thermal output of less than 140 KW with the standard model. To increase the thermal output the high grade option was chosen in connection with an absorption heat pump.

The high grade section supplies the generator of the heat pump and the low grade section supplies the evaporator. This combination enables a thermal output to the hot water loop up to 190 KW.

In the reported period the thermal output was as follows:

Low grade and high grade heat	1256 MWh
cooling module	1001 MWh
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Sum	2257 MWh

ELECTRICAL OUTPUT

The produced electrical energy is used either for own demand or can be delivered to the grid.

Electrical energy, delivered to the grid	1534 MWh
Electrical energy, from electricity network	7 MWh
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MEAN TIME BETWEEN FAILURES

The longest continuous run occurred from 9/7/1998 till 12/31/98 for an amount of 2764 hours.

The run was terminated for a manual shutdown, without this shutdown the plant should have run from 5/13/1998 for 4938 hours.

The reported period has 8760 h and the fuel cell runs during this time 7972 h. The reliability was 91.0%. This is a very good performance since 2% of the shutdown time was related to the installation of the high grade retrofit kit and works on the hot water system external to the power plant.

The estimated Mean Time Between Failure is 1990 hours.

The MTBF value achieved by this power plant during the first year of operation is good and the actual operations promises to get better results.

COST BENEFITS

For the fuel cell project in Nuremberg the costs are the following:

Non recurring costs =	1.985.300 DM
(Fuel cell power plant foundation, costs for planning....)	

Operating costs =	229.409 DM
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Heat benefit =	53.402 DM
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Benefit by delivering electrical energy =	156.395 DM
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The total cost benefit balance without non recurring costs is -19.612 DM

A negative benefit means uneconomical fuel cell working. The payback time calculation is not possible.

4. CERTIFICATION

CLC S.r.l., Erdgas Energie Systeme Gmbh and EWAG certify that it has complied in all respects with the grant under DE-FG21-96MC33360, Climate Change Fuel Cell Program and that the related efforts required by that grant are now fully complete including twelve months of operation and submission of the Final Report herein supplied. Such report is in compliance with Paragraph 4 of DOE's Special Terms and Conditions for Research Projects Grants for Climate Change Fuel Cell Program.

5. CONCLUSIONS

Particularly promising applications are:

- ?? Hospitals and health care facilities and generally the buildings having favorable thermal recovery potentials and where at least some importance is attached to power quality and reliability.
- ?? Selected or isolated locations having grid capability constraints where long, expensive, or time-consuming capacity upgrades are otherwise required.
- ?? Data centers, communication facilities, and manufacturing plants where power quality and grid reliability are of particular concern.

For these reasons, dispersed generation locations at hospitals, computer centers, and the like are considered to be attractive market entry prospects for fuel cells. One mode of this application would be a premium power configuration where the fuel cell dispatches a full 200 KW to the grid during normal periods, and reverts to a grid independent supply for local customer loads during any grid interruption.